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# BASIC DIMENSIONS OF TRADE AND SERVICE FUNCTIONS AND THEIR SPATIAL ASPECTS IN MICHIGAN

BY

PENTTI YLI-JOKIPII

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University of Florida
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## ABSTRACT

This statistical study has the purpose of investigating the uni- or multidimensionality of retail trade, wholesale trade and service functions. The study area is Michigan, and the data are by counties. Correlation and principal axis factor analysis and varimax rotation are the techniques employed. One strong, basic dimension of trade and service functions occurred. Another, considerably weak, basic dimension characterizing tourist functions emerged, and the third weak dimension represented services frequently needed. The spatial distribution of basic dimensions is described cartographically by means of factor scores, while the examination of factors influencing spatial distribution is performed by correlation and regression analyses.

## PROBLEM, DATA, METHODS

In economic geography retail trade, wholesale trade and services are sometimes treated as altogether separate phenomena, sometimes again combined under the term tertiary economic activity neglecting the exact explanation of the justification for combination or classification. How separate phenomena are these actually in terms of spatial distribution? This statistical study has the purpose of investigating the uni- or multidimensionality of retail trade, wholesale trade and service functions. Michigan was arbitrarily selected as the study area. Enterprise numbers of kind-of-business groups of retail trade, wholesale trade and selected services, as classified in the U.S. 1967 Census of Business (1969), were selected for the analysis by county units. The techniques employed to illustrate the question of whether the above kind-of-business groups (20 in number) constitute one or more basic dimensions are correlation and principal axis factor analysis and varimax rotation. Should more basic dimensions emerge, it will be interesting to discover if they conform with the traditional trisection into retail trade, wholesale trade and services.

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The author was a visiting scholar in the Department of Geography, Michigan State University, during 1970 sponsored by the American Council of Learned Societies.

*Table 1. Correlation coefficients between kind-of-business groups of retail trad »Extensive material» (all counties in Michigan).**

| | | Kind-of-business groups | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| X 1. | RT | Building materials, hardware, and farm equipment dealers | 1.00 | | | |
| X 2. | RT | General merchandise group stores | .99 | 1.00 | | |
| X 3. | RT | Food stores | .96 | .98 | 1.00 | |
| X 4. | RT | Automotive dealers | .99 | .99 | .96 | 1.00 |
| X 5. | RT | Gasoline service stations | .99 | .99 | .99 | .99 |
| X 6. | RT | Apparel and accessory stores | .98 | .99 | .99 | .98 |
| X 7. | RT | Furniture, home furnishings, and equipment stores | .99 | .99 | .98 | 1.00 |
| X 8. | RT | Eating and drinking places | .95 | .97 | .99 | .95 |
| X 9. | RT | Drug stores and proprietary stores | .98 | .99 | .99 | .98 |
| X 10. | RT | Miscellaneous retail stores | .99 | .99 | .99 | .99 |
| X 11. | RT | Nonstore retailers | .99 | .98 | .95 | .98 |
| X 12. | WT | Merchant wholesalers | .97 | .98 | .99 | .97 |
| X 13. | WT | Other operating types | .97 | .97 | .95 | .96 |
| X 14. | SS | Hotels, motels, tourist courts, camps | .85 | .88 | .90 | .86 |
| X 15. | SS | Personal services | .98 | .99 | .99 | .98 |
| X 16. | SS | Miscellaneous business services | .98 | .98 | .97 | .98 |
| X 17. | SS | Auto repair, auto services, garages | .98 | .99 | .99 | .98 |
| X 18. | SS | Miscellaneous repair services | .99 | .99 | .98 | .99 |
| X 19. | SS | Motion pictures | .97 | .98 | .99 | .96 |
| X 20. | SS | Other amusement, recreation services | .97 | .98 | .99 | .97 |

RT = Retail Trade WT = Wholesale Trade SS = Selected Services

* All correlation coefficients significant at the 0.01 level

After an answer to the above problem is established the following questions arise: What are the spatial aspects of the basic dimension or dimensions in the study area and which factors, such as population size, density and income, explain these aspects. It is possible to describe spatial distribution cartographically by means of factor scores, while the examination of factors influencing spatial distribution may be performed by correlation and regression analyses. Since the data for this study are aggregated at the county level it is further possible to conclude, relying on the results of the analysis, to what extent a county in Michigan is an independent functional unit in terms of trade and services.

*lesale trade and selected services based on number of enterprises in each group.*

| 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | |
| 1.00 | | | | | | | | | | | | | |
| .97 | 1.00 | | | | | | | | | | | | |
| .99 | .99 | 1.00 | | | | | | | | | | | |
| .99 | .98 | .99 | 1.00 | | | | | | | | | | |
| .99 | .94 | .97 | .98 | 1.00 | | | | | | | | | |
| .98 | .99 | .99 | .99 | .96 | 1.00 | | | | | | | | |
| .98 | .94 | .96 | .98 | .98 | .97 | 1.00 | | | | | | | |
| .87 | .90 | .89 | .89 | .85 | .89 | .86 | 1.00 | | | | | | |
| .99 | .99 | .99 | .99 | .97 | .99 | .97 | .89 | 1.00 | | | | | |
| .98 | .96 | .98 | .99 | .99 | .98 | .99 | .88 | .98 | 1.00 | | | | |
| .99 | .99 | .99 | .99 | .97 | .99 | .96 | .88 | .99 | .98 | 1.00 | | | |
| .99 | .97 | .99 | .99 | .99 | .99 | .97 | .88 | .99 | .99 | .99 | 1.00 | | |
| .98 | .99 | .99 | .99 | .96 | .99 | .97 | .90 | .99 | .98 | .99 | .99 | 1.00 | |
| .98 | .99 | .99 | .99 | .97 | .99 | .97 | .90 | .99 | .99 | .99 | .99 | .99 | 1.00 |

## BASIC DIMENSIONS OF TRADE AND SERVICE FUNCTIONS

Correlation coefficients between kind-of-business groups of retail trade, wholesale trade and selected services according to the number of enterprises are shown in Table 1. All counties in Michigan are included in the analysis, and this material is hereafter alluded to as the »extensive material». All correlation coefficients are highly interrelated and significant at the 0.01 level of confidence. Only the correlation coefficients between all variables and variable 14 (hotels, motels, tourist courts, camps) seem to deviate clearly from the other values. This is understood, because service functions associated with tourism frequently constitute small centers in places where the landscape, for example, provides attraction regardless of local population stock (see Palomäki 1967, s. 69). The correlation matrix seems to suggest that kind-of-business groups of retail trade, wholesale trade and services in Michigan constitute only one basic dimension.

Principal axis factor analysis confirms the above hypothesis of the existence of not more than one basic dimension of trade and services (Table 2). The first principal component accounts for a large proportion of variance due to high factor loadings. Kind-of-business groups of retail trade (X1—X11), wholesale trade (X12, X13), as well as services (X14—X20) have high loadings, indicating that no grouping, into basic dimensions according to the traditional trisection, can be distinguished. As the correlation matrix suggests, only variable 14 has, on the first factor, a considerably lower loading than the remaining variables. On the second factor, which, however, explains only one per cent of the total variance, this variable obtains the only significant loading. Similarly, the third principal component is very weak. It may be noted, however, that on this dimension variable 3 (food stores) and variable 8 (eating and drinking places) maintain the highest positive loadings.

To further clarify the character of the basic dimensions of trade and service functions the same correlation matrix was subjected to varimax rotation procedures. The results for the first three factors are shown in Table 2. It is apparent that the first factor of the unrotated solution in this case falls on three factors. The first factor, which can justly be labeled the main dimension of trade and service functions, is also in this analysis noticeably strong. With the exception of variable 14 again, both kind-of-business groups of wholesale trade and all kind-of-business groups of selected services have high loadings on the first factor. Among kind-of-business groups of retail trade variables 3 (food stores) and 8 (eating and drinking places) obtain distinctly lower loadings than the remaining variables. Not unlike the case in the unrotated solution, variable 14 representing tourist functions dominates the second factor of the rotated solution. Variables 3 and 8 have highest loadings on the third factor. Thus, this factor obviously illustrates the dimension characterized by functions frequently required.

The Detroit metropolitan area is composed of three counties within its suburban zone. These are likely to have a notable influence on correlation coefficients due to the quantity of trade and service functions.

*Table 2. Factors 1, 2 and 3 of principal axis factor analysis and those of the varimax rotation, both resulting from the correlation matrix in Table 1, »extensive material» (all counties in Michigan).*

| | | Kind-of-business groups | Principal axis factor analysis | | | After varimax rotation | | |
|---|---|---|---|---|---|---|---|---|
| | | | F 1 | F 2 | F 3 | F 1 | F 2 | F 3 |
| X 1. | RT | Buiding materials, hardware, and farm equipment dealers | .99 | .12 | —.05 | .77 | —.39 | .49 |
| X 2. | RT | General merchandise group stores | .99 | .05 | —.02 | .72 | —.43 | .54 |
| X 3. | RT | Food stores | .99 | —.07 | .11 | .59 | —.47 | .65 |
| X 4. | RT | Automotive dealers | .99 | .11 | —.05 | .76 | —.40 | .49 |
| X 5. | RT | Gasoline service stations | .99 | .03 | .01 | .69 | —.44 | .56 |
| X 6. | RT | Apparel and accessory stores | .99 | .01 | .01 | .69 | —.46 | .56 |
| X 7. | RT | Furniture, home furnishings, and equipment stores | .99 | .07 | —.03 | .73 | —.43 | .52 |
| X 8. | RT | Eating and drinking places | .98 | —.10 | .15 | .55 | —.48 | .68 |
| X 9. | RT | Drug stores and proprietary stores | .99 | —.02 | .06 | .64 | —.46 | .61 |
| X 10. | RT | Miscellaneous retail stores | .99 | .02 | —.01 | .70 | —.46 | .55 |
| X 11. | RT | Nonstore retailers | .98 | .12 | —.12 | .79 | —.42 | .44 |
| X 12. | WT | Merchant wholesalers | .99 | —.04 | .06 | .63 | —.47 | .61 |
| X 13. | WT | Other operating types | .98 | .08 | —.11 | .76 | —.45 | .45 |
| X 14. | SS | Hotels, motels, tourist courts, camps | .90 | —.40 | —.19 | .44 | —.81 | .40 |
| X 15. | SS | Personal services | .99 | —.01 | .06 | .65 | —.45 | .61 |
| X 16. | SS | Miscellaneous business services | .99 | .04 | —.07 | .73 | —.46 | .49 |
| X 17. | SS | Auto repair, auto services, garages | .99 | —.00 | .07 | .65 | —.44 | .62 |
| X 18. | SS | Miscellaneous repair services | .99 | .05 | —.01 | .71 | —.43 | .55 |
| X 19. | SS | Motion pictures | .99 | —.05 | .06 | .63 | —.48 | .61 |
| X 20. | SS | Other amusement, recreation services | .99 | —.04 | .04 | .64 | —.48 | .60 |
| | | Proportion of variance | .98 | .01 | .01 | .46 | .22 | .31 |

RT = Retail Trade WT = Wholesale Trade SS = Selected Services

*Table 3. Correlation coefficients between kind-of-business groups of retail tr*
*»Reduced material» (Wayne, Oakland and Macomb counties omitted).**

| | | Kind-of-business groups | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| X 1. | RT | Building materials, hardware, and farm equipment dealers | 1.00 | | | |
| X 2. | RT | General merchandise group stores | .95 | 1.00 | | |
| X 3. | RT | Food stores | .94 | .97 | 1.00 | |
| X 4. | RT | Automotive dealers | .96 | .98 | .97 | 1.00 |
| X 5. | RT | Gasoline service stations | .95 | .98 | .98 | .98 |
| X 6. | RT | Apparel and accessory stores | .92 | .97 | .96 | .97 |
| X 7. | RT | Furniture, home furnishings, and equipment stores | .94 | .97 | .97 | .98 |
| X 8. | RT | Eating and drinking places | .94 | .97 | .98 | .97 |
| X 9. | RT | Drug stores and proprietary stores | .93 | .98 | .97 | .98 |
| X 10. | RT | Miscellaneous retail stores | .95 | .97 | .96 | .98 |
| X 11. | RT | Nonstore retailers | .94 | .95 | .96 | .96 |
| X 12. | WT | Merchant wholesalers | .85 | .89 | .90 | .89 |
| X 13. | WT | Other operating types | .90 | .89 | .89 | .89 |
| X 14. | SS | Hotels, motels, tourist courts, camps | .21 | .31 | .32 | .28 |
| X 15. | SS | Personal services | .95 | .98 | .98 | .98 |
| X 16. | SS | Miscellaneous business services | .88 | .93 | .92 | .93 |
| X 17. | SS | Auto repair, auto services, garages | .95 | .97 | .97 | .98 |
| X 18. | SS | Miscellaneous repair services | .94 | .96 | .96 | .97 |
| X 19. | SS | Motion pictures | .86 | .90 | .87 | .89 |
| X 20. | SS | Other amusement, recreation services | .93 | .96 | .96 | .96 |

RT = Retail Trade WT = Wholesale Trade SS = Selected Services

* r = 0.20 significant at the 0.1 level
r = 0.24 significant at the 0.05 level
r = 0.30 significant at the 0.01 level

Correlation and principal axis factor analysis and varimax rotation, identical to the ones described above, were employed a second time omitting three counties closest to Detroit (Wayne, Oakland and Macomb). This material is hereafter referred to as the »reduced material». A general review of the correlation matrix reveals that coefficients have become lower (cf. Tables 3 and 1), yet they continue to remain highly interrelated and most are very significant. Clearly the lowest correlation coefficients are obtained between all variables and variable 14. Furthermore, correlation coefficients of variables 12 and 13 remain below the *olesale trade and selected services based on number of enterprises in each group.*

| 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | | | | | | |
| 7 | 1.00 | | | | | | | | | | | | | |
| 6 | .96 | 1.00 | | | | | | | | | | | | |
| 8 | .98 | .97 | 1.00 | | | | | | | | | | | |
| 7 | .98 | .97 | .98 | 1.00 | | | | | | | | | | |
| 5 | .97 | .94 | .97 | .98 | 1.00 | | | | | | | | | |
| 9 | .93 | .88 | .90 | .92 | .96 | 1.00 | | | | | | | | |
| 7 | .91 | .86 | .89 | .91 | .95 | .96 | 1.00 | | | | | | | |
| 9 | .30 | .35 | .31 | .32 | .27 | .29 | .23 | 1.00 | | | | | | |
| 7 | .98 | .98 | .99 | .99 | .97 | .91 | .90 | .27 | 1.00 | | | | | |
| 5 | .94 | .91 | .95 | .96 | .96 | .93 | .91 | .29 | .95 | 1.00 | | | | |
| 6 | .99 | .96 | .98 | .98 | .98 | .94 | .93 | .27 | .98 | .94 | 1.00 | | | |
| 6 | .97 | .95 | .96 | .99 | .98 | .94 | .93 | .26 | .99 | .96 | .97 | 1.00 | | |
| 9 | .88 | .85 | .88 | .90 | .91 | .91 | .90 | .31 | .88 | .92 | .88 | .91 | 1.00 | |
| 5 | .95 | .96 | .96 | .98 | .97 | .91 | .90 | .36 | .97 | .96 | .95 | .97 | .89 | 1.00 |

median, as is the case for correlation coefficients of variable 19 (motion pictures).

The first factor of the unrotated principal axis factor analysis based upon the »reduced material» is also strong and thus unquestionably establishes the main dimension of trade and service functions (Table 4). No less than 91 per cent of the total variance is explained by this factor. Only variable 14 obtains a high loading on the second factor which explains 5 per cent of the total variance. This factor can be termed the basic dimension of tourist functions. Unlike the case in the »extensive material», kind-of-business groups of wholesale trade obtain highest loadings on the third factor. Also variable 19 has a high loading on this factor. Wholesale trade emerges for the first time separately as a weak basic dimension. This factor explains only two per cent of the total variance.

Varimax rotation procedures (Table 4) of the »reduced material» merely confirm the above result of the unrotated solution: the main dimension of trade and service functions is strong, the weak basic dimension of tourist functions is explained by variable 14 alone, and the third factor is dominated by wholesale trade functions.

## SPATIAL ASPECTS OF BASIC DIMENSIONS

By means of factor scores it is possible to describe the spatial distribution of each basic dimension, since scores maintain direct dependance on the correlation matrix. The factor scores are from the rotated solution, and the discussion of spatial distribution relying on the »extensive material» will be given first.

In view of spatial distribution it is interesting to examine the factor scores of the first factor, that is, the main dimension of trade and service functions (Figure 1 a). Wayne and Oakland counties near Detroit and Kent county, where the city of Grand Rapids is situated, acquire the highest factor score values (class I). Class II comprises only the densely populated area of south-east Michigan. Those counties in the southern part of the Lower Peninsula where urban population is relatively scarce are dominated by class III. The counties in the northern part of the Lower Peninsula and in the Upper Peninsula mostly fall in class IV.

Detroit and Oakland obtain the highest factor scores also on the second factor characterized by tourist functions (Figure 1 b). Differences between the southern and northern parts of the Lower Peninsula are smaller than in the factor scores of the first factor. In the Upper Peninsula where both skiing and summer resorts are abundant, many counties obtain positive factor score values.

The third factor with the least proportion of variance was in the »extensive material» termed the basic dimension characterized by functions frequently required. Therefore, the contrast between the southern

*Table 4. Factors 1, 2 and 3 of principal axis factor analysis and those of the varimax rotation, both resulting from the correlation matrix in Table 3. »Reduced material» (Wayne, Oakland and Macomb counties omitted).*

| | | Kind-of-business groups | Principal axis factor analysis | | | After varimax rotation | | |
|---|---|---|---|---|---|---|---|---|
| | | | F 1 | F 2 | F 3 | F 1 | F 2 | F 3 |
| X 1. | RT | Building materials, hardware, and farm equipment dealers | .95 | .11 | .09 | .84 | —.04 | —.48 |
| X 2. | RT | General merchandise group stores | .98 | —.00 | .09 | .84 | —.15 | —.48 |
| X 3. | RT | Food stores | .98 | —.01 | .11 | .85 | —.16 | —.46 |
| X 4. | RT | Automotive dealers | .98 | .03 | .11 | .87 | —.12 | —.47 |
| X 5. | RT | Gasoline service stations | .99 | —.00 | .04 | .83 | —.16 | —.53 |
| X 6. | RT | Apparel and accessory stores | .98 | .01 | .10 | .85 | —.14 | —.48 |
| X 7. | RT | Furniture, home furnishings, and equipment stores | .99 | .01 | .04 | .82 | —.14 | —.53 |
| X 8. | RT | Eating and drinking places | .97 | —.05 | .17 | .88 | —.20 | —.41 |
| X 9. | RT | Drug stores and proprietary stores | .99 | .00 | .09 | .85 | —.15 | —.49 |
| X 10. | RT | Miscellaneous retail stores | .99 | —.01 | .02 | .81 | —.17 | —.54 |
| X 11. | RT | Nonstore retailers | .99 | .05 | —.08 | .76 | —.10 | —.63 |
| X 12. | WT | Merchant wholesalers | .94 | .01 | —.29 | .60 | —.14 | —.77 |
| X 13. | WT | Other operating types | .93 | .08 | —.28 | .60 | —.07 | —.77 |
| X 14. | SS | Hotels, motels, tourist courts, camps | .32 | —.95 | —.02 | .13 | —.99 | —.10 |
| X 15. | SS | Personal services | .99 | .04 | .09 | .86 | —.11 | —.49 |
| X 16. | SS | Miscellaneous business services | .96 | .01 | —.12 | .71 | —.14 | —.64 |
| X 17. | SS | Auto repair, auto services, garages | .99 | .05 | .03 | .82 | —.11 | —.55 |
| X 18. | SS | Miscellaneous repair services | .99 | .06 | —.03 | .79 | —.10 | —.59 |
| X 19. | SS | Motion pictures | .92 | —.02 | —.26 | .59 | —.16 | —.74 |
| X 20. | SS | Other amusement, recreation services | .98 | —.06 | .02 | .80 | —.21 | —.53 |
| | | Proportion of variance | .91 | .05 | .02 | .60 | .07 | .31 |

RT = Retail Trade WT = Wholesale Trade SS = Selected Services

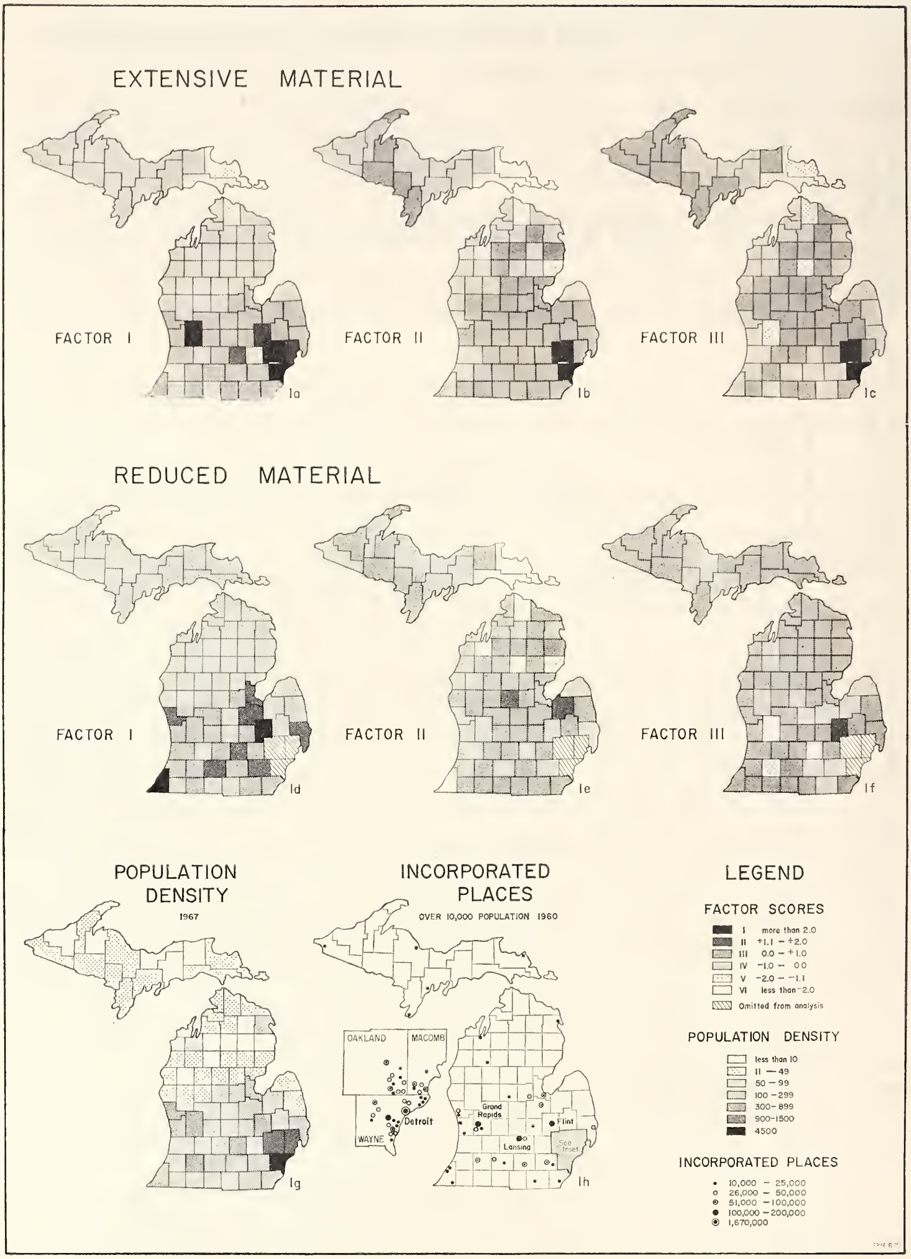

Figure 1. Spatial distribution of basic dimensions (cf. text).

and northern parts of the study area is naturally not so great as, for instance, on the first factor (cf. Figure 1 c).

Factor scores of the three rotated factors of the »reduced material» are shown cartographically in Figures 1 d, 1 e and 1 f. The spatial distribution of the first factor is quite similar to the distribution produced by the »extensive material» (cf. Figures 1 a and 1 d), the identical main dimension of trade and service functions being in question. Differences occur, however, as exemplified by the case of Kent county. In the »reduced material» the spatial distribution of the second factor is perhaps even more uniform than in the »extensive material» (cf. Figures 1 b and 1 e). The third weak factor in the »reduced material» dominated by wholesale trade functions (Figure 1 f) also produces a picture of a rather uniform spatial distribution.

## FACTORS EXPLAINING SPATIAL ASPECTS OF BASIC DIMENSIONS

The relationship between trade and service functions and number of population has been excessively studied from the standpoint of central places (see for instance Stafford 1963, pp. 165—175, Kenyon 1967, pp. 736—750 and Davies 1968, pp. 145—155). Attempts have also been made to classify cities into various role types according to the occurrence of functions. This is, however, most commonly based on the information available in the census of population, and the classification method has mainly been the percentile distribution of labor into fields of occupation. The basic study of this kind was made by Harris (1943). Nelson (1955) has further developed his methods; for Michigan, see also Senninger (1964).

The importance of population number and income to retail trade sales has also been investigated in a number of studies focused on both central places and larger spatial units. Russel (1957), for instance, was able to prove in his copious statistical account the lack of actual correlation between retail trade and population income, when data are aggregated by city units. According to Ferber (1958), regression analyses based on data from Illinois cities revealed that only number of population and distance between cities were statistically significant as independent variables retail trade sales being the dependent variable. Of these two independent variables number of population was by far the more important factor. Thompson (1966), in his treatise of regression analyses of retail trade sales in communities in the vicinity of San Fransisco, had a number of geographical, economic and demographic variables as explanative factors. Only few of these factors proved to be statistically significant. Berry (1963) in his study of the Baltimore area showed with regression analysis that population and relative income have separate and significant effects upon the distribution of retail and service activity. In Finland Siirilä (1969 a and 1969 b) has successfully employed regression analysis in explaining changes in centrality. With these studies as the foundation, it is interesting to proceed to examine on a county basis, which factors explain spatial aspects of the above basic dimensions of trade and service functions. The analysis represents a deviation from the preceeding ones; firstly, in having the data by counties, and secondly,

*Table 5. Variables used in correlation and regression analyses* *

| Dependent variables | | Independent variables | |
|---|---|---|---|
| Y 1 | Factor scores I<br>(main dimension of trade and service functions) | X 1 | Number of population [1] |
| | | X 2 | Population density [1] |
| Y 2 | Factor scores II<br>(Weak dimension characterizing tourist functions) | X 3 | Median income of families [2] |
| | | X 4 | Effective buying income net dollars [3] |
| Y 3 | Factor scores III<br>(extensive material: weak dimension characterizing frequently needed functions)<br>(reduced material: weak dimension characterizing wholesale trade functions) | X 5 | Effective buying income per household [3] |

* Sources of independent variables:

[1] *Michigan Population Handbook 1965.* Michigan Department of Public Health, Lansing 1967 (estimated data from 1967).

[2] *U.S. Census of Population 1960,* Vol. I. Characteristics of the Population, Part 24. Michigan. U.S. Department of Commerce, Bureau of the Census, Washington D.C. 1963.

[3] *Sales Management Magazine.* Survey of Buying Power. June 10. 1968. New York (data from 1967).

by making the number of trade and service functions the starting point of the study.

Factors explaining spatial aspects of basic dimensions will now be examined with correlation and regression analyses. Factor scores will act as dependent variables. Relative and absolute variables representing the population and its income were selected as independent variables (see Table 5).

Correlation coefficients between dependent and independent variables produced by the »extensive material» are shown in Table 6. The coefficients between the main dimension of trade and service functions (factor scores 1) and all independent variables are positive, considerably high and of the same quantity. Factor scores of the dimension typified by tourist functions (Y2) are completely uncorrelated with both relative variables representing local population income. Factor scores of the dimension characterized by tourist functions obtain a significant negative correlation with variables representing absolute population number and density, and absolute effective buying income. This means that sparsely populated and relatively poor areas, in particular, are characterized by tourist functions. Factor scores of the third dimension (Y3), of frequently needed services, are in zero correlation with variables describing relative

*Table 6. Coefficients of simple correlation, »extensive material»*

| | | Y 1<br>Factor scores I | Y 2<br>Factor scores II | Y 3<br>Factor scores III |
|---|---|---|---|---|
| X 1 | Number of Population | 0.67*** | — 0.44*** | 0.59*** |
| X 2 | Population Density | 0.61*** | — 0.43*** | 0.65*** |
| X 3 | Median Income of Families | 0.69*** | — 0.00 | — 0.02 |
| X 4 | Effective Buying Income Net Dollars | 0.68*** | — 0.45*** | 0.56*** |
| X 5 | Effective Buying Income per Household | 0.70*** | 0.02 | — 0.03 |

*** significant at the 0.01 level

population income and relative buying power (Y3 and Y5). In other words, the presence of the functions in this dimension is solely independent from these factors. On the other hand, correlation coefficients are considerably high with variables representing population number, density and absolute buying power.

In the »reduced material» (Table 7) correlation coefficients between factor scores of the main dimension of trade and service functions and population number, density and absolute effective buying income are higher than in the »extensive material», while correlation coefficients between factor scores and variables representing relative income are respectively lower. A high correlation coefficient of population density in particular, may imply that trade and service functions outside large cities are almost solely based upon this explanative factor. Correlation coefficients between independent variables and the dimension of tourist functions remain very low in the »reduced material», and are negative, as in the »extensive material», with the exception of the correlation coefficient of variable X5. The coefficients between independent variables and the dimension characterized by wholesale trade functions are also relatively small and all negative. Consequently, as the

*Table 7. Coefficients of simple correlation, »reduced material»*

| | | Y 1<br>Factor scores I | Y 2<br>Factor scores II | Y 3<br>Factor scores III |
|---|---|---|---|---|
| X 1 | Number of Population | 0.86*** | — 0.10 | — 0.49*** |
| X 2 | Population Density | 0.89*** | — 0.08 | — 0.38*** |
| X 3 | Median Income of Families | 0.67*** | — 0.03 | — 0.26** |
| X 4 | Effective Buying Income Net Dollars | 0.83*** | — 0.11 | — 0.52*** |
| X 5 | Effective Buying Income per Household | 0.58*** | 0.04 | — 0.26** |

*** significant at the 0.01 level
** significant at the 0.05 level

*Table 8. Coefficients of multiple correlation and multiple determination. »Extensive material»* (for independent variables, see Table 5).

| Dependent variables | R | $R^2$ |
|---|---|---|
| Y 1 Factor scores I | .89 | .80 |
| Y 2 Factor scores II | .54 | .29 |
| Y 3 Factor scores III | .84 | .71 |

*Table 9. Coefficients of multiple correlation and multiple determination. »Reduced material»* (for independent variables, see Table 5).

| Dependent variables | R | $R^2$ |
|---|---|---|
| Y 1 Factor scores I | .90 | .81 |
| Y 2 Factor scores II | .22 | .05 |
| Y 3 Factor scores III | .70 | .48 |

cartographical presentation (Figure 1 f) implies, wholesale trade functions are not necessarily based on the population and its buying power inside a county unit, but are explained by other factors, such as for instance traffic location.

Coefficients of multiple correlation and multiple determination between factor scores (Y1, Y2, and Y3) and all independent variables on the basis of the »extensive material» are shown in Table 8. It must be taken into account that due to technical considerations multicollinearity occurs among independent variables. Nevertheless, independent variables explain a markedly high proportion of the first main dimension of trade and service functions. The explanative degree is considerably higher than in some of the above regression analyses of retail trade sales in cities. This is the situation also with the third dimension dominated by frequently needed functions. On the other hand, as could be anticipated on the ground of simple correlation coefficients, the total explanative degree of independent variables pertaining to the second dimension characterized by tourist functions remains rather low.

Coefficients of multiple correlation and multiple determination between factor scores and all independent variables produced by the »reduced material» are shown respectively in Table 9. A very high proportion of the main dimension of trade and service functions is also in this case explained by the independent variables. This proves that a county in Michigan is a distinctly independent functional unit in terms of trade and services. The total explanative degree pertaining to the dimension characterized by tourist functions is, in the »reduced material», even lower than in the »extensive material». The low explanative degree shows, as might be presumed, that tourist functions depend almost entirely on population outside the county. The third dimension of both materials differed from each other. In the former the dimension was characterized by services frequently needed and in the latter, respectively by wholesale functions. In the »reduced material» the total explanative degree of independent variables pertaining to the third dimension remains distinctly lower than in the »extensive material». This indicates that a county is too small a unit to provide adequate economic and demographic premises for wholesale trade functions.

## SUMMARY

This study has dealt with basic dimensions of trade and service functions and their spatial implications. Numbers of functions of kind-of-business groups of retail trade, wholesale trade and selected services in Michigan according to *U.S.* 1967 *Census of Business* were analyzed at the county level. The analyses were made on the basis of both the »extensive material» (all counties in Michigan) and »reduced material» (three urban counties close to Detroit omitted). Principal axis factor analysis and varimax rotation procedures produced one strong, basic dimension of trade and service functions. High loadings were obtained on this dimension by kind-of-business groups of both retail trade, wholesale trade and services. Therefore, strict classification of tertiary economic activity into retail trade, wholesale trade and services is not justified by the evidence of material used in this research. Another, considerably weak, basic dimension characterizing tourist functions emerged both in the »extensive material» and in the »reduced material». The third weak dimension in the »extensive material» represented services frequently needed. In the »reduced material» the respective weak dimension was mostly colored by wholesale trade functions.

Factor scores were employed to illustrate spatial aspects of the basic dimensions. A markedly high proportion of the spatial distribution of the main dimension, characterized by trade and service functions, was explained in the regression analysis by independent variables selected to represent the population and its income. This indicates that any given county in Michigan is a nearly independent functional unit in terms of trade and services. The low explanative degree of independent variables pertaining to the second, weak dimension, dominated by tourist functions, reveals the natural fact that tourist functions obtain their support from out of county population. The weak dimension, characterized by frequently needed services, was well explained in the regression analyses by the chosen set of independent variables, while the weak dimension featured by wholesale trade functions received a relatively poor explanation. County is thus too small a spatial unit to provide premises for wholesale functions.

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